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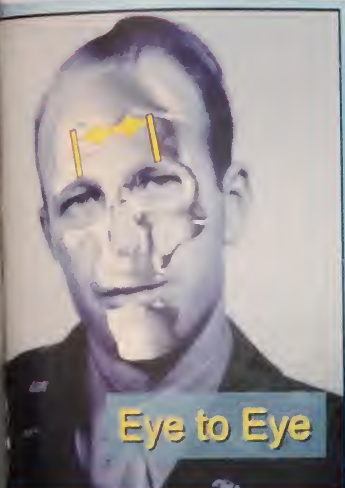

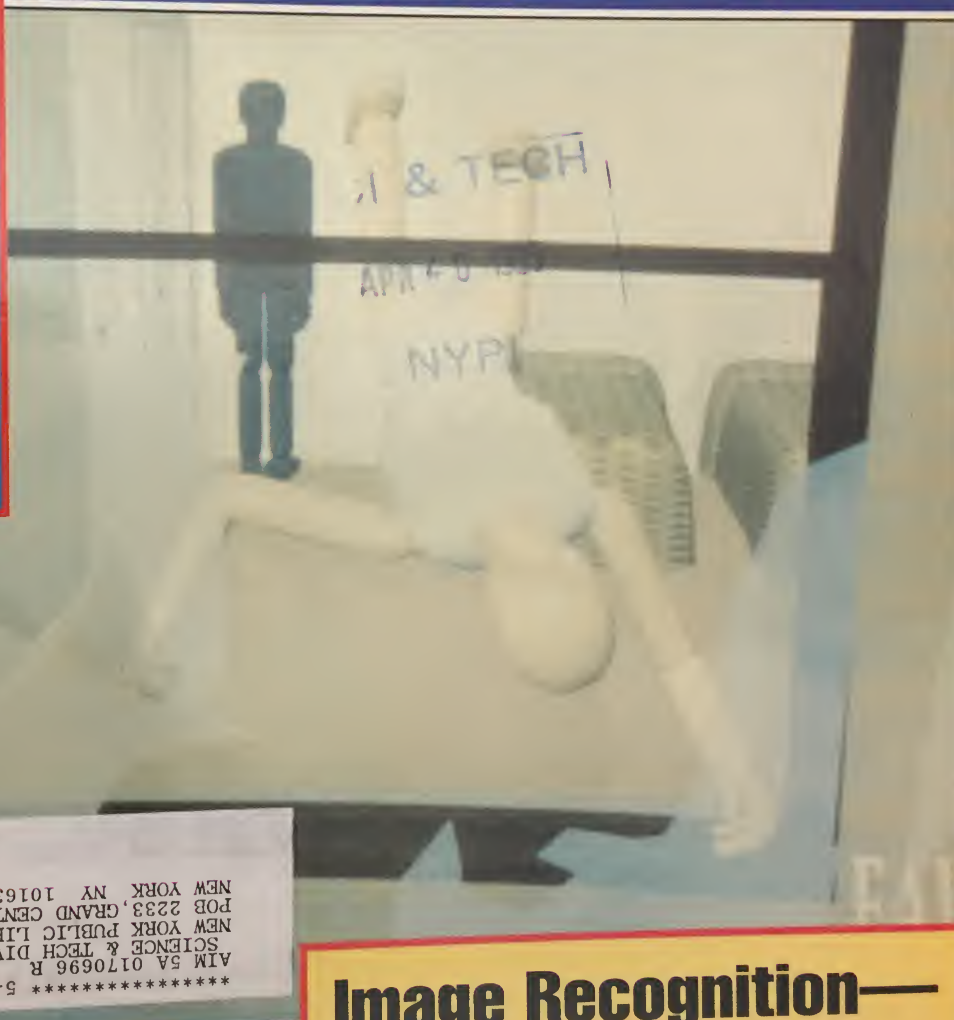

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FEBRUARY 1995
VOLUME 10, NUMBER 2

Today's imaging equipment and service bureau realities. *(See page 46.)*

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COLUMNS

DEPARTMENTS

The cover: From Engineering Animation Inc,. end result of an imaging-based animation exploring controversial death of CIA official in the '50s, and a digital photo/skull scan combination used as an element in getting there. *(See article, page 34.)* Plus, up top: UNIX arts imaging from ISTR. *(See survey, beginning page 28.)*

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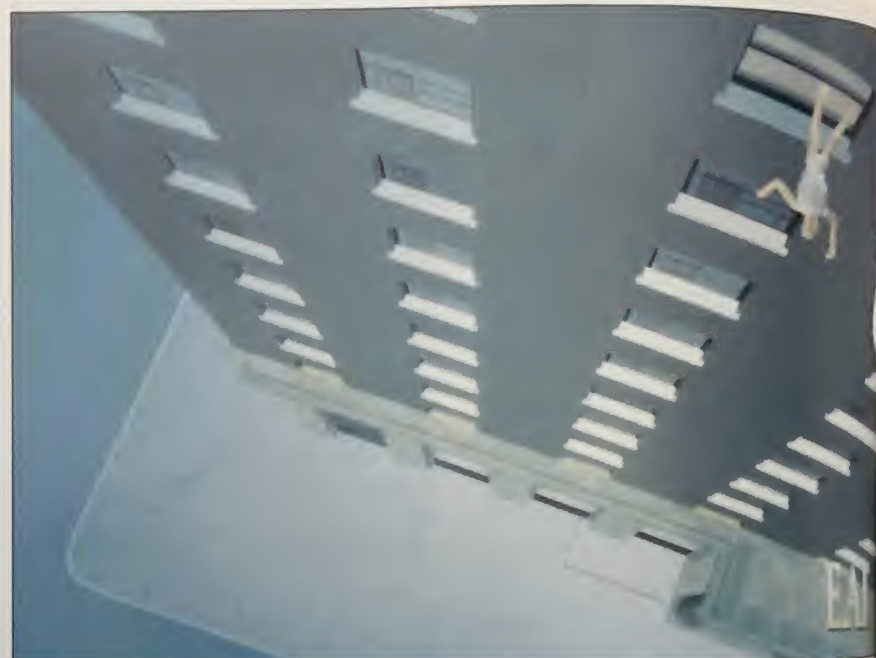
MURDER MOST FOUL?

Imaging, Animated Visualization, and Real-World Death Investigations

BY DR. MARTIN J. VANDERPLOEG

Image-derived data, physics-accurate animation and strong visualization tools mean strong evidence can be supplied in scienific investigations as well as the courtroom



Physics-accurate plunge animation—

The tools that have put new scope and muscle into Hollywood's magic is also—albeit quietly— revolutionizing the science of criminal investigation. Once upon a time you could only dial m for murder, these days you can build a graphic that tells the sordid tale to the world. Tools are becoming a powerful ally in forensic and scientific analysis. Visualization is also becoming more prevalent in the courtroom, and cases with available but mute physical evidence (e.g., O.J. Simpson trial) will benefit greatly from the technique's ability to set static evidence in a kind of re-enacting motion.

Post-mortem CT scan meets digital photo.

New tools can measure relevant objects at investigation sites, (sometimes capturing images of real objects there), and bring data into accurate 3-D visualizations. Constructed graphic images incorporate principles of physics to predict how the original object might have moved, then animate the created object.

Just this past November, a high-profile team of investigators revolutionized forensic science when they used image-based computer animation to help recreate the circumstances surrounding the much-debated 1953 death of Central Intelligence Agency scientist Frank Olson.Olson plunged from the 13th story window of his New York hotel room on November 28, 1953. His death was officially listed as a suicide, but autopsy, police and witness reports were suspiciously inconsistent. The Olson family refused to believe that he had plunged from the window intentionally.

In 1975, Congressional investigators revealed that the CIA had given Olson LSD without his knowledge, in a chemical warfare experiment. That open revelation invited speculation about whether Olson jumped, fell, ran or was thrown or pushed through the window. The exact circumstances remained a mystery. Computer animation built on hard evidence filled in the gaps.

The Starrs visualization

The investigative team, led by prominent George Washington University law professor and forensic scientist James Starrs, had big plans for 3-D modeled visualization. They planned to use computer animation rather than traditional methods to recreate the scene of Olson's death, and test and refine their

Dr. Martin J. Vanderploeg is executive vice president of Engineering Animation, Inc. Ames Iowa (The firm also has offices in New York, Los Angeles and Chicago). He has published extensively and has 15 years of experience in mechanical engineering and technical consulting for the automotive, biomedical and litigation communities.

Researchers...measuring...street...dummy.

theories. The success of computer animation technology in these plans opens remarkable new research opportunities, and as we will say, accurate, grabbed real-world imagery lie at the heart of the visualization and animation process.

The investigative team's first task was to exhume Olson's body. Researchers performed a second autopsy for comparison with the original autopsy and the police reports from 41 years ago.

Because Olson's dental records no longer existed, they could not be used to positively identify the remains. Instead, the team relied on computer technology to confirm the identity of the skeleton.

Researchers put the exhumed skull through a computed tomography (CT) scan to produce serial slice x-ray images. Biomedical engineers at Engineering Animation, Inc. (EIA, of Ames, Iowa) used the scan data to create a scientifically accurate three-dimensional computer model of Olson's skull. Digital photos of Olson were then superimposed over the computer model using EAI's 3-D animation software, VisLab—which has been adopted for animated scientific visualization use by the likes of Merck, Johnson & Johnson, CNN, General Motors and the Houston Musuem of Natural Science.

"Once it was a model in the computer, we could change the scale and position of the skull to align it with the field of view and angle in the photograph, identifying facial features using lines as overlay images," says Mike Sellberg, biomedical engineer with Engineering Animation, which was brought in as a member of the investigative team because of its experiencein re-creating events with scientific accuracy.

The Olson team compared three standard facial measurements in anthropological studies: the distance between eyes, between ears, and from the top of the crown to the chin. (Like fingerprints, each of these distances is considered a unique identifying characteristic in humans.) The digital image of Olson matched the skull model in all three measurements.

"Generating a computer model was the key to accurate verification of the remains," says Sellburg. "The skull either matches up to the facial features of the superimposed photo, or it *doesn't*." Using computer technology and photos for identification, he explains, provides a significant re-source to supplement or replace traditional identification methods that rely on hair samples and dental records, which are not always readily available.

Computer re-creation:
"The only answer"

Where the body ended up, ofcourse, is largely a result of where it started before the fall. Here's a sketch of the known facts: In 1953, the front of the Hotel Statler was being steam-cleaned.An eight-foot wooden barrier was placed on the sidewalk just below Olson's hotel room window. The wounds on the exhumed body indicated that it must have hit this wooden barrier *before* landing on the sidewalk. Nice bit of detective work. But the team still needed to determine how the disgruntled scientist got from the hotel bed to the sidewalk below.

—and the likely scenario behind it!

"We needed to detemine whether he had enough room to run to the window," says Starrs. The alternative? "He could have been pushed, or could have tripped over the radiator and still made it out through the glass," Starrs notes.

After 41 years, the wooden barrier was long gone, and the hotel room had undergone changes. A new air conditioning unit had been placed in front of the window. A new window frame had been installed that changed the window's dimensions slightly. Alterations to the ducts changed the dimensions of the room altogether, making the original placement of the beds impossible to re-create in the real world. Instead,EAI animation engineers used photographs, measurements and hotel floor plans (a role for document imaging and mapping in recreations) to create a model of the hotel, the room, the barrier and the sidewalk.

"The 3-D computer models let us envision the scene the way it must have looked in the 1950s," Starrs said. "Computer animation let us interact with our theories in a very real, visual, and above all, scientifically accurate manner."

Motion visualization revelations

Working backwards from the computer models of the building and the sidewalk, and information about the position, condition and location of the body helped investigators determine the velocities necessary to project it out the window in order to land in the stated position. Once dynamic factors were determined, EAI engineers created animations that helped rule out theories that did not fit the known data.

EAI created animations that depicted Olson exiting the window at a range of speeds. Scenarios included stepping off the windowsill, running at full speed, and being thrown or pushed.

"We knew right away we could narrow

the possibilities," said Sellberg. "Since we knew Olsen had to hit the barrier on the way down, there were only a few ways he *could* have left the window."

The CIA agent who shared Olson's hotel room claimed he awoke to the sound of the window breaking, so researchers estimated the range of speeds the body could have attained in the space between the bed and the window, then how his velocity would have been reduced if he crashed through the window.

Combined with the known path of the fall, and final position on the sidewalk, the physics behind the animations revealed inconsistencies in the factual descriptions of the 1953 case. EAI's analysis of Olson's exit through the window put traditional views of his death in serious question; investigators concluded that the circumstances were strongly suggestive of foul play.

"Computer animation in this case has given us a large leap forward in our ability to reconstruct a crime scene and the occurrence at the crime scene," says Starrs. Animated visualization of an incident gives a much firmer basis for drawing conclusions about the occurrence itself, he postulates.

Computer animation also proved to be a powerful tool for the Olson investigative team when the time came to *explain* their findings last November at the National Press Club in Washington DC. The animations captured audience attention because they were powerfully visual, technologically innovative and skillfully prepared. They were able to communicate technical information visually in a way that fostered understanding and excitement.

"Not only did the animations help our investigations," said Starrs, "but they made it easy for even the most skeptical observer to see the logic of our conclusions. This was a case where we needed superb real-world animations, and EAI's technology delivered even beyond our expectations," Starrs said.

Animations explain expert testimony

At EAI, we have now used computer animation to illustrate complicated technical evidence for non-technical audiences in hundreds of legal cases, using VisLab animation software to enforce the laws of physics in the animation.

The cases have been wide-ranging. In different lawsuits, VisLab has taken viewers on animated tours of shopping malls, chemical plants, race tracks and crime scenes. EAI animations have been used to reconstruct aviation accidents, simulate complex surgical procedures, show the differences in patented machinery and show how hazardous chemicals travel underground.

In one truck accident, a woman was seriously injured when her bicycle collided with a semitrailer truck. She claimed the accident was the truck driver's fault. Engineers from EAI studied the physical evidence, and built accurate computer models of the truck, the bicycle, and the intersection where the collision took place. By recreating the woman's own account of the accident, engineers convinced the jury that the woman had plenty of time to avoid the truck.

In another case, a resident blamed a house fire on a broken gas pipe. First, EAI used animation to show how the fire spread through the house. The animation showed that smoke damage found in the burnt-out structure was more likely caused by a cigarette smoldering on a sofa than by a gas explosion. Next, EAI simulated a gas fire in the same house. The animation showed that in a real gas fire, the beams near the gas pipe would be scorched by flame and walls of the house would be blown apart. Since the beams were intact and the house was still standing after the blaze, the smoldering cigarette seemed a more likely cause of the accident.

Imaging, physics and accuracy

Because moving objects in EAI's scientific animations obey the laws of physics as they would in the real world, EAI's

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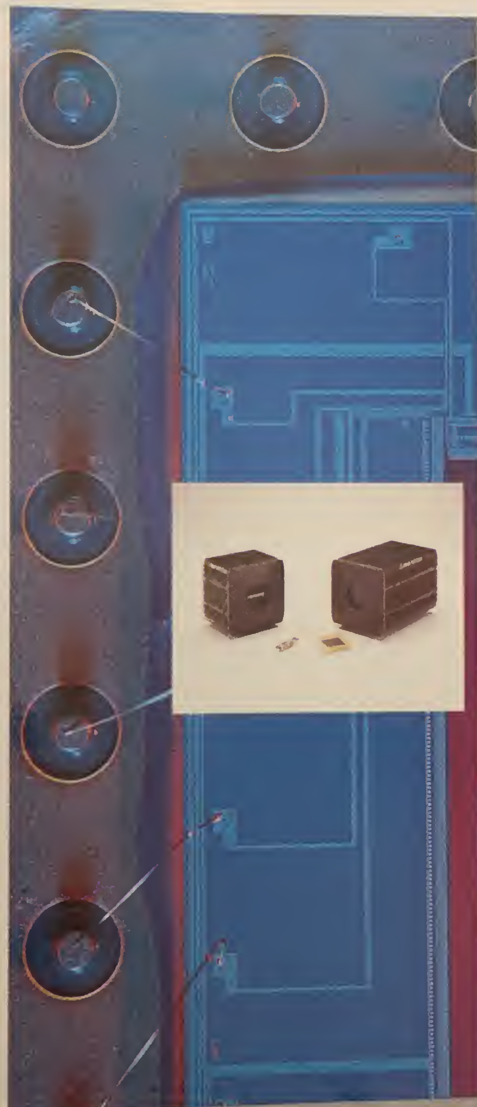

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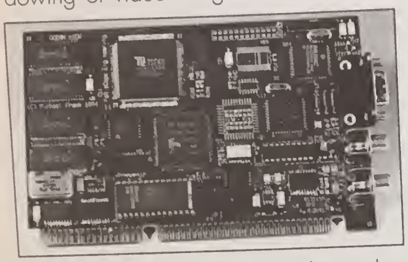

PAL signal sources (Camcorder, video recorder, off-air video, etc.), in a freely selectable window with the functionality of a VGA graphics board. The video window can be scaled from full screen down to icon size (32X32 pixels) with resolutions of 1024X768 dpi in 256 possible colors. Using the TH6200 VideoScaler multimedia integrated circuit (by Thesys Microelectronics) and the ET4000/W32I high performance graphics accelerator chip (Tseng abs Corp.). The TH6200 performs real-time filtering, sizing and clipping of digital info. for presenting video sequences on a PC monitor operating under Microsoft Windows. PeRisCope ENGINEERING GmbH

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VANDERPLOEG

(continued from page 37)

computer animation technology offers exciting new research tools to the scientific community—as well as a method for communicating a project's complex, technical information.

Objects and events can be animated from any point of view. Split screens can show multiple viewpoints simultaneously. Computer "cameras" are capable of graphic pans, zooms and viewpoints impossible for real cameras—even electronic imaging cameras!

Animation speed can change to help illustrate complex relationships between objects. Slow motion animation and a "freeze-frame" of a view of pistons can explain how engine failure occurred. Time-lapse animation can show, in a few seconds, an event that occurs over a period of years.

Cross-sections, highlight colors and textures, and other detailing can focus attention on a particular part in a scene, or mechanism of an object. And, of course, actual digital photographs and video can dissolve into animation to emphasize the animation's realism. Investigators can use computer animation to understand and refine complex theories, and illustrate their findings for others. ■

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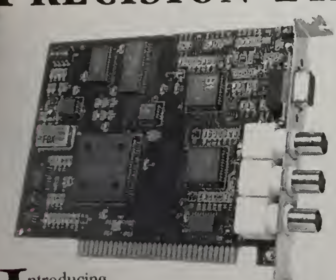

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REES

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comes a host of related technology that shows great promise for use in medical centers and other health care facilities. Interactive touch screen kiosks are being implemented in hospital lobbies and doctor's offices and used by visitors and customers as an information source for everything from basic health care and surgical information to hospital floor plans and maps. And, medical professionals are finding interactive kiosks to be excellent instructional tools. Visiting doctors can access information about specific procedures and techniques that the host facility is performing, or study patient information for consultation purposes. There are strong potential roles for Photo CD in these. Patient instructional programs have been converted from conventional slide shows to Photo CD. Now, patients and their families can review information on what to expect from their treatments and how to administer follow-up care at their own pace and from the privacy of their rooms.

Photo CD is being embraced by the health care industry as a valuable tool in communication, education *and* record keeping. As the technology continues to develop, professionals, administrators and educators in the medical community are finding new and exciting ways to improve the way they communicate by using Kodak Photo CD. ■